

Research on the shield tunnel lining with the FRPM Pipe

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(Purpose)

On the method (following, FRPM pipe method) which uses the FRPM pipe as shield tunnel lining, the private technical-evaluation proof had been awarded to Several companies from 1992 to 1994. And the excellent functions such as workability, watertight, etc. were verified by comparing to conventional method of the concrete secondary tunnel lining. Afterwards, the construction results had been achieved with concentration of the small diameter shield. In such situation, the correspondence to internal and external hydraulic pressure and multifunctional cross section, the anticorrosive and earthquake-proof were demand for the high functional enhancement in addition to the functions of conventional secondary lining, when the future sewerage shield sewer was considered.

In this study, The FRPM pipe is applied to sewerage shield sewer, and arrangement of the performance evaluation method (test method, standard value) for turning to the function enhancement and examination for the practical application are carried out, and the technical manual which coordinated the fundamental consideration in plan and design is made.

(Result)

(1) On improvement of resistance of internal and external hydraulic pressure

The FRPM tube can construct the shield tunnel which can deal with internal hydraulic pressure and external hydraulic pressure acting to sewer, since it has high watertight performance of both shells and joints. And, the safety of the shell has been confirmed on the buckling strength for external hydraulic pressure of the pipe by the Amstutz formula at the JSWASK-16 standard.

(2) On improvement of the earthquake- proof

The earthquake-proof issue of the FRPM pipe method is that ensure the safety of the pipe, and water tightness of the pipe to permission bending angle of the joint and extraction allowances for level 1 and level 2 earthquake, based on "earthquake proof countermeasure guideline and explanation of the sewerage facilities, Japan sewerage association (1997) ".

(3) On improvement of chemical resistance and acid resistance.

FRPM pipe used by the FRPM pipe method has the performance of satisfying chemical corrosion resistance test and acid proof test regulated at JSWASK-16.

(4) On reduction of the excavation cross section.

As the FRPM pipe method, it is possible to reduce the excavation cross section with an identical finishing inside diameter, because the thickness of the secondary lining is less than the concrete secondary lining. And, it is possible to ensure identical discharge for even smaller finishing inside diameter than concrete secondary lining, when the roughness coefficient was considered.

(5) On possibility of construction period shortening.

When FRPM pipe method is used, the average driving distance per day is about the double of conventional method, for more excellent in the workability than the concrete secondary lining. Labor saving and efficiency improvement of the work can be therefore attempted through the whole construction, it becomes about 20m/day on the driving quantity in the straight section, and the shortening of construction period becomes more possible than the concrete secondary lining.

(6) On correspondence to the multifunctional cross section

By performances such as resistance of internal hydraulic pressure, water tightness and secondary lining thickness of the FRPM pipe being little, multiple sewer such as conveying pipe, optical fiber cable and electric power tube can be laid in the identical cross section.

On the base of knowledge mentioned, the necessary items in correspondence to the FRPM pipe method were arranged as a technical manual.

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Key Words

FRPM pipe, shield tunnel, secondary lining